Reappraisal of Normal Amniotic Fluid Index in an Asian Population: Analysis of 27,088 Records

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SUMMARY

Objective: Amniotic fluid index (AFI) is a very useful index for assessing fetal well-being. In 1998, a study of AFI in mainland China showed that AFI values in normal pregnancies were less than those in Western populations. Therefore, we attempt to investigate whether fetal AFI in our population is less than that in Western populations.

Materials and Methods: We reviewed our computerized ultrasound database for fetal AFI from January 1991 to December 2002. For the 12-year study period, only the fetuses that fit the following criteria were included: (1) gestational age ranging from 14 to 41 weeks; (2) singletons, and (3) average-for-gestational-age as evaluated by ultrasound examination. Eventually, 27,088 records were included for the final analysis.

Results: The gestation-specific AFI showed patterns that were similar to those previously reported for the Western populations, with the mean being 10.6 cm at 14 weeks, increasing to 16.2 cm at 22 weeks, and then gradually declining to 12.7 cm at 40 weeks. In addition, the mean AFI in our population was greater than that in a Chinese population from mainland China. The best-fit regression line was a second-order polynomial regression line.

Conclusion: To the best of our knowledge, our series is the largest sample of AFI reported in the medical literature. Our AFI data in Taiwan were closer to those in Western populations and greater than those in a Chinese population from mainland China. The underlying causes are still unknown. Further international collaborative studies are warranted. [*Taiwan J Obstet Gynecol* 2007;46(3):260–263]

Key Words: amniotic fluid index, Asian population, normal pregnancy

Introduction

Hydramnios is associated with anomalies or aneuploidy [1], whereas oligohydramnios is linked with pulmonary hypoplasia, postural deformity, perinatal morbidity, and death [2]. A meta-analysis revealed that an amniotic fluid index (AFI) of ≤ 5.0 cm, in comparison with > 5.0 cm, was associated with an increased risk of cesarean delivery for fetal distress and lower Apgar score [3]. Therefore, AFI is a useful index for assessing fetal well-being.

In 1998, a study of AFI from mainland China [4] showed that the values of normal AFI in the Chinese pregnancies were consistently and substantially lower than the data reported in previous studies of Western populations [5–7]. We speculate that AFI values in Chinese were less than those in other populations around the world, without any reasonable rationale. As the Taiwanese population is relatively close geographically to the Chinese population, we attempt to investigate whether or not the fetal AFI in Taiwanese populations was less than that in Western populations.

Materials and Methods

We retrospectively reviewed our computerized ultrasound database of fetal AFI from January 1991 to December

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Accepted: March 29, 2007

2002. The data included the examination date, AFI, average-for-gestational-age fetus, and estimated body weight as evaluated by ultrasound examination. For the 12-year study period, only the fetuses that fit the following criteria were included: (1) gestational age ranging from 14 to 41 weeks, (2) singletons, and (3) average-for-gestational-age as evaluated by ultrasound examination. We excluded cases with incomplete data or uncertain last menstrual period. Eventually, 27,088 records were included for the final analysis.

The ultrasound measurements followed a previous method reported by Phelan [8]. All examinations were performed using an ALOKA SSD 650 or 680 (Tokyo, Japan) with a 3.5-MHz real-time abdominal scanner. The mean and the standard deviation of AFI for each gestational age were calculated. The Student's *t* test was used for evaluating the difference between each gestational age. Linear regression analysis and polynomial regression analysis (up to the fourth order) were undertaken. In addition, the mean values in the study were compared with those reported in the Western population [5] and the mainland Chinese population [4].

Results

The Table presents the sample sizes, mean, median, standard deviation, and *p* values of AFI for each gestational age from the 27,088 cases. The gestation-specific AFI showed patterns that were similar to those of previous reports, with the mean being 10.6 cm at 14 weeks, increasing to 16.2 cm at 22 weeks, and then gradually declining to 12.7 cm at 40 weeks. The linear regression equation was $y=-0.0995x+17.811$ ($R^2=0.0304$). With polynomial regression analysis up to the fourth-order, the second-order polynomial regression was $y=-0.0231x^2+1.2343x-0.3961$ ($R^2=0.0759$) and was the best-fit polynomial regression equation (Figure 1). The median AFI values observed in this study were similar to those in Western populations and greater than those reported in a population from mainland China (Figure 2).

Table. Amniotic fluid index in a normal Taiwanese population

Gestational age (wk)	Number of cases	Mean (cm)	Median (cm)	SD	*p**
14	22	10.6	10.7	2.9	
15	111	11.6	11.7	3.3	0.159
16	292	12.0	11.9	3.2	0.249
17	359	12.7	12.7	3.3	0.010†
18	368	13.0	13.2	3.2	0.132
19	386	13.9	13.9	3.4	0.000§
20	1,346	15.5	15.4	3.3	0.000§
21	3,266	15.8	15.9	3.3	0.001‡
22	3,678	16.2	16.2	3.3	0.000§
23	1,728	16.2	16.2	3.3	0.829
24	1,038	16.0	16.1	3.5	0.062
25	849	16.1	16.1	3.6	0.512
26	714	16.1	16.1	3.6	0.734
27	666	16.0	15.8	3.7	0.521
28	723	15.9	15.7	3.7	0.449
29	725	15.6	15.7	3.5	0.211
30	915	15.2	15.1	3.7	0.032†
31	846	15.1	14.9	3.7	0.433
32	968	14.6	14.4	3.9	0.007‡
33	943	14.5	14.4	3.7	0.554
34	1,054	14.4	14.3	3.9	0.416
35	1,034	14.2	13.9	3.9	0.210
36	1,212	13.8	13.5	4.0	0.043†
37	1,398	13.8	13.6	4.0	0.759
38	1,269	13.2	12.7	4.3	0.000§
39	792	13.0	12.6	4.5	0.386
40	335	12.7	12.1	4.5	0.224
41	51	13.1	12.3	4.7	0.550

**Student's t test; †$p<0.05$; ‡$p<0.01$; §$p<0.001$; SD = standard deviation.*

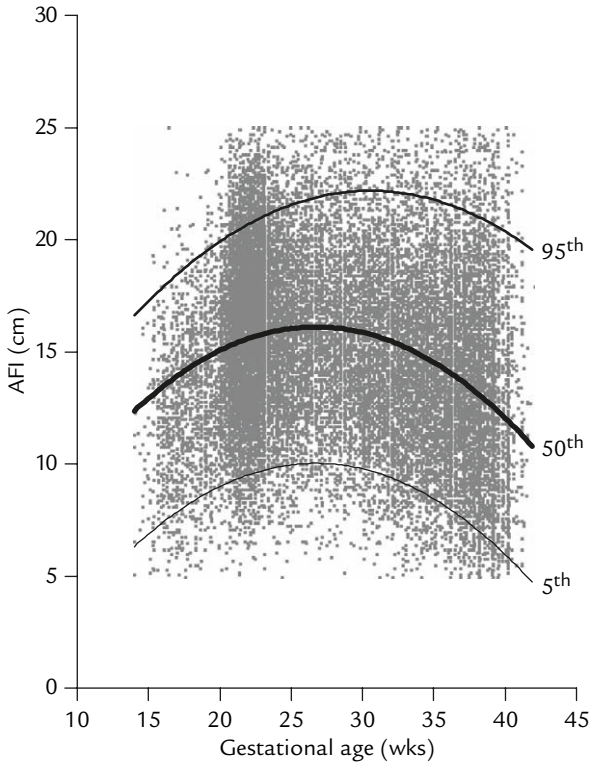

Figure 1. The second-order polynomial regression (—) of the gestation-specific amniotic fluid index (AFI) is $y=-0.0231x^2+1.2343x-0.3961$ ($R^2=0.0759$). The others curves represent the 5th percentile (—) and the 95th percentile (—). Individual data points are shown.

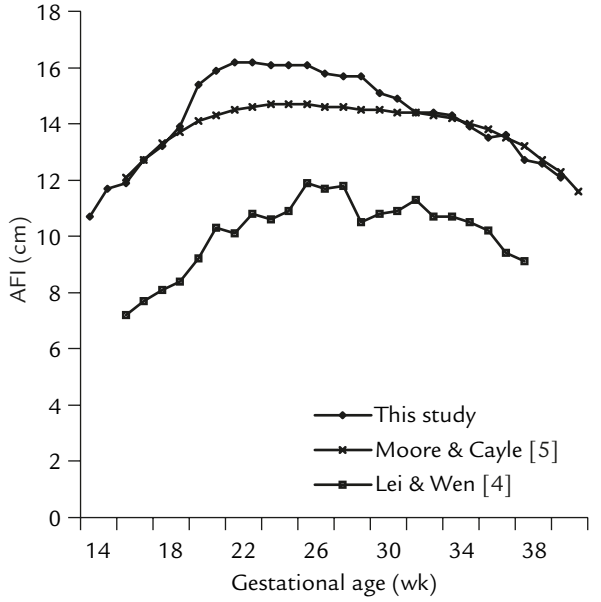

Figure 2. The mean gestation-specific amniotic fluid index (AFI) in three populations.

Discussion

Nowadays, ultrasonographic assessment of amniotic fluid is used frequently to identify fetuses at risk of adverse outcome. The American College of Obstetricians and Gynecologists [9] states that AFI is a more accurate and reproducible method of determining abnormalities in amniotic fluid volume than are other techniques. Given the ethnic differences, it is important to have an AFI reference for each population. The median AFI from the Western population [5] reported a mean of 12.1 cm at 16 weeks (initial), 14.7 cm at 24 weeks (maximal), and 11.0 cm at 42 weeks (terminal). The median AFI from mainland China [4] was 7.2 cm at 16 weeks (initial), 11.9 cm at 26 weeks (maximal), and 9.1 cm at 40 weeks (terminal). In our study, the gestation-specific AFI showed patterns that were similar to those of previous reports [5], with the median being 10.7 cm at 14 weeks (initial), increasing to 16.2 cm at 22 weeks (maximal), and then gradually declining to 12.1 cm at 40 weeks (terminal) (Figure 2). Our AFI data in Taiwanese were closer to those in Western populations [5–7] and were greater than those in a Chinese population from mainland China [4].

The underlying causes for the smaller AFI in a Chinese population from mainland China are still unknown. Geographically, the Taiwanese population is relatively close to the Chinese population. Lei et al [4] proposed that parity might play an important role, because almost all subjects in their study were in their first pregnancy [4], whereas the Western population [5–7] had fewer cases of primiparity than Lei et al's series [4]. Nevertheless, in our study, more than half of our subjects were in their first pregnancy. According to Lei et al's proposal, our AFI might be between their values and values from the West. But this was not observed in our study. Therefore, we consider parity as not an important factor in AFI. Further study for the relationship between parity and AFI might be needed.

Phelan et al [8] used an AFI of 5 cm as the lower limit and 20 cm as the upper limit for normal AFI. A meta-analysis also revealed that an AFI of ≤ 5.0 cm, in comparison with > 5.0 cm, was associated with an increased risk of cesarean delivery for fetal distress and an Apgar score of < 7 at 5 minutes [3]. In contrast, Carlson et al [10] suggested that polyhydramnios should be defined by an AFI of 24 cm or more. Once the diagnosis of polyhydramnios is made, the patient should have a detailed sonographic evaluation, be offered cytogenetic studies, and have antepartum surveillance. In our study, most of the AFI values were in the range between 5 and 25 cm. Therefore, it would be reasonable to set the lower and upper limits of normal AFI as 5 and 25 cm, respectively, in Taiwanese population.

To the best of our knowledge, our series is the largest sample of AFI reported in the medical literature. We believe that our AFI values in normal pregnancies may

be of interest in the field of maternal–fetal medicine. Our AFI data may be important reference for clinical application in obstetrics.

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